

Relationship between Severity of Footpad Dermatitis and Carcass Performance in Broiler Chickens

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ABSTRACT. The relationship between the severity of footpad dermatitis (FPD) and growth performance parameters (live weight, condemnation rate, leg meat yield and breast meat yield) was investigated in a total of 63 million broiler chickens that were processed over a period of 1,053 days between 2008 and 2012 at a full-scale processing plant in Kagoshima Prefecture, Japan. FPD scores and carcass data were summarized daily and analyzed to determine their correlations. It was found that FPD severity was positively correlated with the condemnation rate and negatively correlated with the live weight and leg meat yield. These results indicate that controlling FPD may play an important role in reducing condemnations while improving live weight and leg meat yields.

KEY WORDS: broiler, carcass performance, footpad dermatitis.

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Footpad dermatitis (FPD) in poultry is a type of contact dermatitis [6] that has been known about for decades with the first reports dating back to sometime around 1969 in turkeys, broilers and layers [1, 11, 15]. The incidence of FPD is especially high in broilers and turkeys reared on wet litter floors, because their footpads are in constant contact with wet litter for long periods of time, which predisposes the birds to dermatitis [10, 12, 13, 17, 18]. Once dermatitis develops, the lesions often become more severe due to secondary infection with bacteria that originate from the birds' excrement or the environment, and in most cases, lesions do not heal or improve.

Severe FPD can be a significant cause of economic loss, as chicken feet are highly valued for human consumption, especially in Southeast Asia. Japan also exports chicken feet to these countries, but feet with severe lesions are not acceptable as export products and must be used as a source of processed foodstuffs in the home market.

FPD has also been a welfare concern, as it may cause discomfort to birds, and foot quality has been discussed as an indicator of poultry welfare, especially in Europe [2-5, 14]. This welfare concept has gradually permeated through Japan as well, raising awareness in the poultry industry.

Previously, we reported the high prevalence of FPD, which develops as early as 1 week of age and advances in both severity and incidence with age, in broilers in Tohoku and South Kyushu areas in Japan [7]. Histopathological and

microbiological examinations of the FPD lesions have also been performed [8].

In the field, severe FPD lesions can be observed even in birds with clinically excellent growth, but conversely they are not always observed in birds that are emaciated or that exhibit poor growth. Many factors are thought to be involved in the development of FPD on farms. Therefore, statistical analysis of the effect of FPD on growth performance is difficult in small restricted studies or experiments.

In the present study, we examined the correlation between the severity of FPD and broiler growth performance parameters using data from a commercial processing plant in Kagoshima Prefecture that had been routinely recording the status of FPD for all birds processed. This processing plant, established in 1975 and operated by a private company, was processing approximately 60,000 birds/day from about 30 farms in Kagoshima and 50 others outside Kagoshima, totaling about an average of 17 million birds annually. Although the farm size ranged from 14,000 to 85,000 birds/farm, similar husbandry practices and food and hygiene materials were used in accordance with the guidelines provided by a commercial broiler integration company. Chickens were of the Chunky breed and were processed at an average of 52 days of age (range: 49 to 55 days). The company had been exporting about 500 tons/year of frozen chicken paws to Southeast Asia for human consumption over the past 17 years.

Among growth performance parameters, the live weight is calculated as the mean of the live weights of all birds that entered the processing plant, the carcass condemnation rate is the proportion of carcasses that were condemned entirely at the processing plant out of all the inspected live birds, and the edible meat (leg and breast meat) yield is the proportion of the total weight of the edible meat among the total weight of the slaughtered birds. These growth performance param-

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Table 1. Spearman's rank correlation coefficients among FPD score, live weight, carcass condemnation rate, leg meat yield and breast meat yield

	FPD score	Live weight	Condemnation rate	Leg meat yield	Breast meat yield
FPD score	1.000	-0.130 *	0.361 *	-0.436 *	-0.013
Live weight		1.000	-0.195 *	-0.304 *	0.607 *
Condemnation rate			1.000	-0.092 *	-0.202 *
Leg meat yield				1.000	-0.331 *
Breast meat yield					1.000

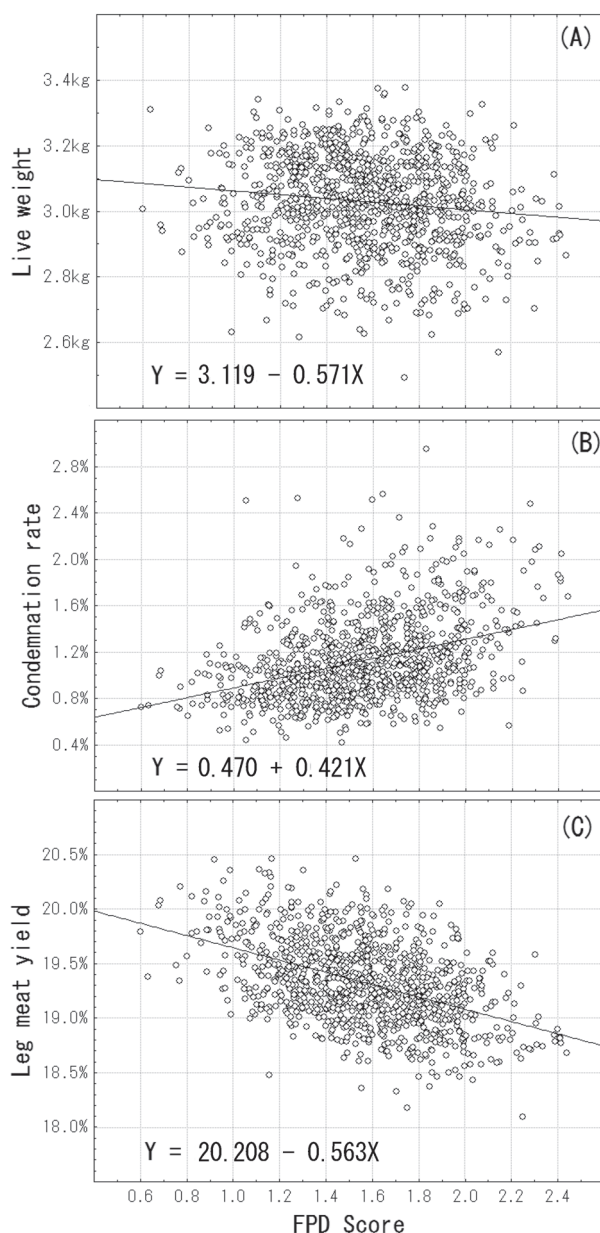
* Significantly different from zero ($P<0.05$).

Fig. 1. Scatter diagram of FPD scores and three of the parameters. (A) FPD score and live weight. (B) FPD score and condemnation rate. (C) FPD score and leg meat yield.

eters were recorded on a daily basis. Evaluation of FPD was performed in a manner similar to that described previously [7]. Briefly, all carcasses were inspected visually for footpad condition after removal from the processing chain and skinning and were scored on a 4-point scale (0 to 3). Feet with a score of 2 or less were acceptable for exportation, and those with a score of 3 were suitable only for domestic consumption.

FPD score, live weight, condemnation rate, leg meat yield and breast meat yield data were extracted from the processing plant's database, and their daily mean values were used for statistical analysis. Statistical software (Statistica; StatSoft, Tokyo, Japan) was used to calculate the Spearman's rank correlation coefficient and to construct scatter plots.

The results of the correlation analysis are summarized in Table 1. A positive correlation ($P<0.05$) between the FPD score and the condemnation rate and a negative correlation ($P<0.05$) between the FPD score and the live weight and leg meat yield were observed. Additionally, there was a highly positive correlation ($P<0.05$) between live weight and breast meat yield.

Figure 1 shows three scatter diagrams with simple regression lines of the daily mean FPD score and (A) live weight, (B) condemnation rate and (C) leg meat yield, respectively, over a period of 1,053 days. As shown in Fig. 1, the daily mean FPD score showed a negative association with the live weight ($Y=3.119-0.571X$, $r=-0.130$, $t(n-2)=-4.240$, $P=0.000$) (Fig. 1A), a positive association with the condemnation rate ($Y=0.470+0.421X$, $r=0.361$, $t(n-2)=12.559$, $P=0.000$) (Fig. 1B) and a negative association with the leg meat yield ($Y=20.208-0.563X$, $r=-0.436$, $t(n-2)=-15.723$, $P=0.000$) (Fig. 1C).

To our knowledge, this is the first report that suggests the impact of FPD on broiler performance or carcass grade. Our previous study showed that FPD is prevalent among Japanese farms with a great variability in incidence [7], although its impact on broiler performance was not investigated. Some farm managers believe that farms severely affected by FPD generally have poor growth performance, but this has not been scientifically demonstrated. Our results, however, certainly raise the possibility that by controlling FPD, fewer condemnations and increased leg meat yield can be achieved.

A positive correlation between FPD severity and condemnation rate means that when the number of condemned live birds or carcasses is high, the mean FPD score is also likely high on the same day. Although FPD was evaluated only

for the carcasses that passed inspection, our results suggest that condemnation tends to increase in poultry populations with more severe FPD. A negative correlation between FPD severity and live weight or leg meat yield may indicate that the presence of FPD negatively affects the leg muscle mass development in broilers, as the birds with severe FPD spend less time walking. The correlation between FPD severity and live weight or breast meat yield is obviously less than that between FPD severity and condemnation rate or leg meat yield. The correlation between other parameters, except for FPD severity, is also shown in Table 1. Live weight correlated with condemnation rate and leg meat yield negatively but correlated with breast meat yield positively. This suggests that live weight gain is due to breast meat, not leg meat. Condemnation rate was negatively correlated with leg meat yield and breast meat yield. It is not easy to explain or discuss this negative correlation. There was negative correlation between leg meat yield and breast meat yield. This means that it is difficult to expect a simultaneous increase in leg and breast meat yields. These results are very interesting; however, it is very difficult to explain or discuss them more in detail, because a lot of factors were involved in broiler production.

It has been reported that FPD has no association with body weight [9] but does have an association with a low production index [16]. Thus, the association between FPD and growth performance has been a significant concern in the broiler industry, but its true role with regard to the productivity of commercial broiler chickens is still not understood.

To evaluate the impact of FPD severity on the growth performance of the broilers, the effects of the between-farm differences should have been considered in the data analyses. However, the objective of the present study was to understand the overall trends, and it is not practical for farmers to record these data on a daily basis due to the huge amount of additional labor required, which would interrupt their daily farm management. Therefore, data accumulated and summarized in the processing plant were utilized in the present study.

In conclusion, the present study indicates that controlling FPD may play an important role in reducing condemnations while improving live weight and leg meat yields. Much attention should be paid to FPD not only for animal welfare but also for improvement of broiler performance.

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